TITLE OF THE INVENTION

APPARATUS, METHOD AND PROGRAM FOR COMMUNICATION

5   ## BACKGROUND OF THE INVENTION

Field of the Invention

[0001]   The present invention relates to a communication

apparatus such as a facsimile machine, a communication

10   method, and a program, and more particularly, to a facsimile

machine having a capability of facsimile transmission

according to the ITU-T recommendation V.17.

Description of the Related Art

[0002]   In the art of communication apparatus, a facsimile

15   machine or the like is known which has a capability of

facsimile communication according to the ITU-T

recommendation V.17.   In the facsimile communication

according to the ITU-T recommendation V.17, when a long

training/TCF signal is received, training information

20   (correction value by means of training) is fixed

(hereinafter, referred to as "frozen"), while, during an

operation of receiving a short training/picture signal,

training information is frozen each time a carrier of a

picture signal is detected.

25   [0003]   Even when training information is frozen, if a

modem is set into a mode in which a short training/picture
signal is received, training information is adaptively
updated.

[0004]   However, when facsimile communication is performed
by using a particular modem, if an echo is generated in a
communication line having a delay, an echo of a CFR signal
(according to the ITU-T recommendation V.21) transmitted
from a receiving facsimile machine is received by the
receiving facsimile machine. The receiving facsimile
machine incorrectly recognizes the received echo signal as a
carrier of a picture signal and adjusts training data on the
basis of the echo of the CFR signal. In this case, even if
a correct short training/picture signal arrives thereafter,
the receiving facsimile machine cannot receive it (more
precisely, the received signal cannot be correctly
demodulated).

[0005]   The above problem is described in further detail
below with reference to Figs. 10 and 11. When a high-speed
signal (picture signal) is not found (cannot be correctly
demodulated), one possible operation which may occur in a
receiving facsimile machine is, as shown in Fig. 10, timeout
of a T2 timer according to the ITU-T recommendation T.30.
In this case, the receiving facsimile machine terminates the
current communication. Fig. 11 shows another possible
operation. In this example, when a picture signal is not

correctly received, if a receiving facsimile machine finds

PPS-Q, the receiving facsimile machine transmits PPR to

request retransmission of the picture signal.

5   SUMMARY OF THE INVENTION

[0006]   An object of the present invention is to provide a

communication apparatus such as a facsimile machine, a

communication method, and a program, which allow a modem to

10   correctly perform facsimile communication even when an echo

is generated in a communication line having a delay, by

handling an echo signal in such a manner that when an echo

of a CFR signal (according to the ITU-T recommendation V.21)

transmitted from a receiving communication apparatus is

15   received by the receiving communication apparatus, the echo

signal is not recognized as a carrier of a picture signal

and training data is not adjusted on the basis of the

received echo signal, thereby making it possible to receive

a correct short training/picture signal which arrives

20   thereafter.

[0007]   Further objects, features and advantages of the

present invention will become apparent from the following

description of the preferred embodiments with reference to

the attached drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0008]   Fig. 1 is a block diagram showing a facsimile machine according to an embodiment of the present invention.

[0009]   Fig. 2 is a diagram showing a protocol executed by the facsimile machine shown in Fig. 1 when there is no echo, information indicating success in training and information indicating that a carrier is detected.

[0010]   Fig. 3 is a diagram showing a protocol executed by the facsimile machine shown in Fig. 1 when there is an echo, information indicating success in training and information indicating that a carrier is detected.

[0011]   Fig. 4 is a flow chart showing an operation of the facsimile machine shown in Fig. 1.

[0012]   Fig. 5 is a flow chart showing an operation of the facsimile machine shown in Fig. 1.

[0013]   Fig. 6 is a flow chart showing an operation of the facsimile machine shown in Fig. 1.

[0014]   Fig. 7 is a flow chart showing an operation of the facsimile machine shown in Fig. 1.

[0015]   Fig. 8 is a flow chart showing an operation of the facsimile machine shown in Fig. 1.

[0016]   Fig. 9 is a flow chart showing an operation of the facsimile machine shown in Fig. 1.

[0017]   Fig. 10 is a diagram showing a protocol executed

by a conventional facsimile machine when there is an echo.

[0018]   Fig. 11 is a diagram showing a protocol executed

by a conventional facsimile machine when there is an echo.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

[0019]   Fig. 1 is a block diagram showing a facsimile

machine FS1 according to an embodiment of the present

invention.

[0020]   In the facsimile machine FS1, an NCU (network

control unit) 2 is a device which makes it possible to

perform data communication or the like using a telephone

line 2a. The NCU 2 is connected at an end of the telephone

line 2a and controls connection to the telephone line 2a.

When data communication is performed, the NCU 2 connects a

data communication line to the telephone line 2a and holds a

loop. More specifically, in accordance with a command

received via a bus 26, the NCU 2 connects the telephone line

2a to a telephone device 4 (by turning off CML) or to a

facsimile machine (by turning on CML). Note that the

telephone line 2a is normally connected to the telephone

device 4.

[0021]   A hybrid circuit 6 separates a transmitting signal

and a received signal from each other. More specifically,

if the hybrid circuit 6 receives a transmitting signal from
an adder 12, the hybrid circuit 6 transfers the transmitting
signal to the telephone line 2a via the NCU 2. On the other
hand, if the hybrid circuit 6 receives a signal from the

5   outside via the NCU 2, the hybrid circuit 6 transfers the
received signal to a modem 8 via a signal line 6a.

[0022]   The modem 8 performs modulation and demodulation
in accordance with the ITU-T recommendations V.8, V.21,
V.27ter, V.29, V.17, and/or V.34 in a transmission mode

10   specified by a command supplied via the bus 26. If the
modem 8 receives a transmitting signal via the bus 26, the
modem 8 modulates the transmitting signal and outputs
resultant modulated data to a signal line 8a. On the other
hand, if a received signal is input to the modem 8 via the

15   signal line 6a, the modem 8 demodulates the received signal
and outputs resultant demodulated data to the bus 26.

[0023]   If a calling circuit 10 receives a signal
indicating telephone number information via the bus 26, the
calling circuit 10 outputs a DTMF selection signal to a

20   signal line 10a.

[0024]   An adder 12 adds information supplied via a signal
line 8a and information supplied via signal line 10a and
outputs a result to a signal line 12a.

[0025]   A reading circuit 14 outputs read data to the bus

25   26.

[0026]   A recording circuit 16 records, line by line, information supplied via the bus 26.

[0027]   A memory 18 functions as a work memory (RAM) and also as a memory for storing raw information associated with read data or encoded information. The memory 18 is also used to store received information or decoded information received via the bus 26.

[0028]   An operation control panel 20 includes a one-touch dialing key, an abbreviated dialing key, ten-keys, a *-key, a #-key a start key, a stop key, a set key, and other function keys. If information is input by pressing one or more keys, the input information is output over the bus 26. The operation control panel 20 also includes a display for displaying information supplied via the bus 26.

[0029]   A CPU (central processing unit) 22 is responsible for generally controlling the facsimile machine FS1 and executes a facsimile transmission control procedure in accordance with a control program stored in a ROM 24.

[0030]   Fig. 2 shows a protocol executed in the present embodiment when there is no echo. Information indicating that training information has been successfully received and information indicating that a high-speed carrier has been detected are also shown in Fig. 2.

[0031]   In this case, if the modem 8 receives a TCF signal and detects a 0-signal continuing for 1 sec, the CPU 22

commands the modem 8 to freeze (fix) training data. When
the modem 8 receives a picture signal and detects a high-
speed carrier, the CPU 22 also commands the modem 8 to
freeze training data.

5 [0032] Furthermore, when the modem 8 receives the TCF
signal and detects the 0-signal continuing for 1 sec, the
CPU 22 reads the training data from the modem 8 and stores
it into the RAM 18. Similarly, when the modem 8 receives
the picture signal and detects the high-speed carrier, the
10 CPU 22 reads the training data from the modem 8 and stores
it into the RAM 18.

[0033] When a PPS-MPS signal is received, an MCF signal
is transmitted, and receiving of a short training/picture
signal is started. On the other hand, when a PPS-EOM signal
15 is received, an MCF signal is transmitted and then a DIS
signal is transmitted. When a CTC signal is received, a CTR
signal is transmitted and receiving of a long
training/picture signal is started.

[0034] After completion of transmitting the CTR signal,
20 the CPU 22 commands the modem to release the freezing of the
training data.

[0035] Fig. 3 shows a protocol executed in the present
embodiment when an echo is detected. Information indicating
that training information has been successfully received and
25 information indicating that a high-speed carrier has been

detected are also shown in Fig. 3.

[0036]   In this case, if the modem receives a TCF signal and detects the 0-signal continuing for 1 sec, the CPU 22 commands the modem 8 to freeze training data. When the modem 8 receives the picture signal and detects the high-speed carrier, the CPU 22 also commands the modem 8 to freeze training data.

[0037]   In this specific example, an echo of a CFR signal transmitted from the receiving communication apparatus is received by the receiving communication apparatus, and a high-speed carrier is detected. In response, the CPU 22 commands the modem 8 to freeze training data.

[0038]   If the modem receives a TCF signal and detects the 0-signal continuing for 1 sec, the CPU 22 reads the training data from the modem 8 and stores it. After the receiving communication apparatus detects the high-speed carrier of the echo of the transmitted CFR signal, if success in training is detected, the CPU 22 reads stored training data which was detected when there was no echo, and the CPU 22 sets it into the modem 8. When the modem 8 receives a picture signal and detects a high-speed carrier, the CPU 22 reads the training data from the modem 8 and stores it into the RAM 18.

[0039]   When a PPS-MPS signal is received, an MCF signal is transmitted and receiving of a short training/picture

signal is started. On the other hand, when a PPS-EOM signal

is received, a MCF signal is transmitted and then a DIS

signal is transmitted. When a CTC signal is received, a CTR

signal is transmitted and receiving of a long

5   training/picture signal is started. In this case, after the

CTR signal is transmitted and immediately before the long

training signal is received, the CPU 22 commands the modem 8

to release the freezing of the training data.

[0040]   A ROM 24 stores a program for realizing, in a

10   facsimile machine having the capability of communication

according to the ITU-T recommendation V.17, means for, when

long training information is received, storing the training

information, means for detecting a success in receiving

short training information, means for detecting high-speed

15   data, means for setting the stored training information into

the modem 8, and control means for changing the receiving

operation in response to detection of short training

information and high speed data.

[0041]   More specifically, in the case in which high-speed

20   data is detected after short training information is

detected, training information, which was stored when long

training information was received, is not set into the modem

8 when the short training information is received. In the

case in which short training information is detected after

25   high-speed data is detected, training information, which was

stored when long training information was received, is set

into the modem 8 when the short training information is

detected. When a picture signal is received, if short

training information is successfully received, the training

5   information is stored. The process described above is

performed in accordance with the program stored in the ROM

24.

[0042] The operation performed in the present embodiment

is described in further detail with reference to flow charts

10   shown in Figs. 4 to 9.

[0043] In step S2, memory 18 is initialized via the bus

26. In step S4, the display of the operation control panel

20 is cleared via the bus 26. In step S6, the CML of the

NCU 2 is turned off via the bus 26.

15   [0044] In step S8, it is determined whether a facsimile

reception operation is selected. If the facsimile reception

operation is selected, the process proceeds to step S12.

However, if the facsimile reception operation is not

selected, the process proceeds to step S10 to perform other

20   processing. In step S12, the CML of the NCU 2 is turned on

via the bus 26. In step S14, the timeout value of a timer

T1 is set to 35 sec. In step S16, the timeout value of an

ANSam timer is set to 5 sec. In step S18, an ANSam signal

is transmitted.

25   [0045] In step S20, it is determined whether a CM signal

is detected. If a CM signal is detected, the process proceeds to step S22. However, a CM signal is not detected, the process proceeds to step S24. In step S22, the remaining process including the V.8 procedure, V.34 picture transmission, and V.34 procedure is performed.

[0046]   In step S24, it is determined whether timeout occurs in the ANSam timer. If timeout has occurred in the ANSam timer, the process proceeds to step S26. However, if timeout has not yet occurred in the ANSam timer, the process proceeds to step S20.

[0047]   In step S26, a V.21 NSF/CSI/DIS signal is transmitted. In step S28, the timeout value of a timer T4 is set to 3 sec.

[0048]   In step S30, it is determined whether a V.21 NSS/TSI/DCS signal is received. If a V.21 NSS/TSI/DCS signal is received, the process proceeds to step S40. However, a V.21 NSS/TSI/DCS signal is not received, the process proceeds to step S32.

[0049]   In step S32, it is determined whether a V.8 CI signal is received. If a V.8 CI signal is received, the process proceeds to step S34. However, if a V.8 CI signal is not received, the process proceeds to step S36.

[0050]   In step S34, it is determined whether timeout has occurred in the T1 timer. If timeout has occurred in the T1 timer, the process proceeds to step S6. However, if timeout

has not occurred in the T1 timer, the process proceeds to step S16.

[0051]   In step S36, it is determined whether timeout has occurred in the T4 timer. If timeout has occurred in the T4 timer, the process proceeds to step S38. However, if timeout has not yet occurred in the T4 timer, the process proceeds to step S30.

[0052]   In step S38, it is determined whether timeout has occurred in the T1 timer. If timeout has occurred in the T1 timer, the process proceeds to step S6. However, if timeout has not occurred in the T1 timer, the process proceeds to step S26.

[0053]   In step S40, a V.21 NSS/TSI/DCS signal is received.

[0054]   In step S42, it is determined whether communication is that according to the ITU-T recommendation V.17. If the communication is according to the ITU-T recommendation V.17, the process proceeds to step S48. If the communication is not according to the ITU-T recommendation V.17, the process proceeds to step S44.

[0055]   In step S44, a picture signal receiving process is performed. In step S46, a post procedure is performed. In step S48, a long training/TCF signal is received.

[0056]   In step S50, it is determined whether a TCF signal with a level "0" has been continuously received for 1 sec. If a TCF signal with a level "0" has been continuously

received for 1 sec, the process proceeds to step S58.
However, if a TCF signal with a level "0" has not been
continuously received for 1 sec, the process proceeds to
step S52.

[0057]   In step S52, it is determined whether the
receiving of the long training/TCF signal is completed. If
the receiving of the signal is completed, the process
proceeds to step S54. However, the receiving of the signal
is not completed, the process proceeds to step S48.

[0058]   In step S54, it is determined whether timeout has
occurred in the T1 timer. If timeout has occurred in the T1
timer, the process proceeds to step S6. However, if timeout
has not occurred in the T1 timer, the process proceeds to
step S56.

[0059]   In step S56, a V.21 FTT signal is transmitted. In
step S58, the CPU 22 commands the modem 8 to freeze the
training data. Herein, when training data is frozen, the
frozen training data is perfectly fixed in general cases.
However, when a long training/TCF signal, a short
training/picture signal, or a long training/picture signal
is being received, the training data is adaptively and
gradually adjusted.

[0060]   In step S60, the training data is read from the
modem and stored in the RAM 18. In step S62, in response to
receiving a TCF signal, V.21 CFR signal is transmitted.

Herein, it is assumed that the TCF signal is received successfully.

[0061]   In step S64, a short training/picture signal is received.

[0062]   In step S66, it is determined whether a high-speed carrier has been detected. If a high-speed carrier has been detected, the process proceeds to step S68. However, a high-speed carrier has not been detected, the process proceeds to step S64. Herein, in this loop to step S64, a timer is set to prevent a line from being uselessly captured, although the process associated with the timer is not described in further detail.

[0063]   In step S68, the CPU 22 commands the modem 8 to freeze the training data.

[0064]   In step S70, it is determined whether success in receiving training information is detected. If success in receiving training information is detected, the process proceeds to step S72. However, if success in receiving training information is not detected, it is determined that the received signal is an echo of the CFR signal transmitted in step S62, and the process proceeds to step S96. Herein, when success in receiving training information is not detected, the received signal is not short training data but an echo of the CFR signal, and thus the training data frozen in step S60 is not stored. On the other hand, if success in

receiving training information is detected, correct short training information has been received, and thus the training data frozen in step S60 is stored.

[0065]   In step S72, the training data is read from the modem and stored in the RAM 18. In step S74, a picture signal receiving process is performed. In step S76, an intermediate procedure is performed. Herein, it is assumed that a picture signal is received successfully without encountering any error.

[0066]   In step S78, it is determined whether a PPS-EOM signal is received. If a PPS-EOM signal is received, the process proceeds to step S80. However, if a PPS-EOM signal is not received, the process proceeds to step S84.

[0067]   In step S80, a V.21 MCF signal is transmitted. In step S81, a V.21 NSS/TSI/DCS signal is received. In step S82, in order to again perform training, the CPU 22 commands the modem 8 not to freeze the training data. Thereafter, the process returns to step S48.

[0068]   In step S84, it is determined whether a PPS-MPS signal is detected. If a PPS-MPS signal is detected, the process proceeds to step S86. However, if a PPS-MPS signal is not detected, (that is, if a PPS-EOP signal is received), the process proceeds to step S92.

[0069]   In step S92, a V.21 MCF signal is transmitted. In step S94, a V.21 DCN signal is received.

[0070]   In step S96, it is determined whether a high-speed

carrier is detected. If a high-speed carrier is not

detected, the process proceeds to step S98. (In this case,

in response to detecting a high-speed carrier, it is

5   determined that there is no longer an echo of the

transmitted CFR signal.) If a high-speed carrier is detected,

the process returns to step S96. (In this case, in response

to detecting a high-speed carrier, it is determined that

there is still an echo of the transmitted CFR signal.)

10   Herein, in this loop to step S96, a timer is set to prevent

a line from being uselessly captured, although the process

associated with the timer is not described in further detail.

[0071]   In step S98, the training data is read from the

modem and stored in the RAM 18. This is performed because

15   the training data obtained in step S68 is wrong training

data, correct training data, which was stored before step

S68, is set into the modem 8 thereby preventing the

receiving operation from being performed in accordance with

the wrong training data. For example, when a picture signal

20   including a plurality of pages is being received, if an

error due to an echo occurs during short training for a

second or following page, short training can be performed on

the basis of short training data associated with a previous

page thereby making it possible to correctly receive the

25   picture signal.

[0072]   In step S100, a short training/picture signal is received.

[0073]   In step S102, it is determined whether a high-speed carrier has been detected. If a high-speed carrier is detected, the process proceeds to step S104. However, if a high-speed carrier is not detected, the process proceeds to step S100. Herein, in this loop to step S100, a timer is set to prevent a line from being uselessly captured, although the process associated with the timer is not described in further detail.

[0074]   In step S104, the CPU 22 commands the modem 8 to freeze the training data.

[0075]   In step S106, it is determined whether success in receiving training information is detected. If success in receiving training information is detected, the process proceeds to step S108. However, if success in receiving training information is not detected, the process proceeds to step S6.

[0076]   In step S108, the CPU 22 reads the training data from the modem 8 and stores it.

[0077]   In step S110, a picture signal is received. In step S112, an intermediate procedure is performed. Herein, it is assumed that the picture signal can be received successfully without encountering any error.

[0078]   In step S114, it is determined whether a PPS-EOP

signal is detected. If a PPS-EOP signal is received, the process proceeds to step S92. However, a PPS-EOP signal is not received, the process proceeds to step S116.

[0079]   In step S116, it is determined whether a PPS-MPS is detected. If a PPS-MPS signal is detected, the process proceeds to step S118. However, if a PPS-MPS signal is not detected, (that is, if a PPS-EOM signal is received), the process proceeds to step S80.

[0080]   In step S118, a V.21 MCF signal is transmitted.

[0081]   Although in the embodiments described above, it is assumed that the communication apparatus is a facsimile machine, the present invention may also be applied to another type of communication apparatus having a capability of communication according to the ITU-T recommendation V.17. For example, the invention may be applied to a communication apparatus including a modem and installed in a personal computer.

[0082]   Note that the embodiments described above can also be implemented in the form of programs. More specifically, one embodiment described above can be implemented in the form of a program for causing a communication apparatus to execute a procedure in communication in accordance with the ITU-T recommendation V.17, the procedure comprising the steps of storing training information when long training information is received, detecting success in receiving

short training information, detecting high-speed data,

setting the stored training information into a modem, and

changing the receiving operation in response to detecting

short training information and high-speed data.

5   [0083]   Another embodiment described above can be

implemented in the form of a program for causing a

communication apparatus to execute a procedure comprising

the steps of performing long training and short training,

acquiring first training information on the basis of

10   training performed in the training step, acquiring second

training information on the basis of training performed in

the training means, after the acquisition of the first

training information in the first training information

acquisition step, receiving information in accordance with

15   the second training information acquired in the second

training information acquisition step, detecting success in

training, and detecting a high-speed carrier, wherein when a

high-speed carrier is detected but success in training is

not detected, receiving of information in the receiving

20   information step is performed without using the second

training information.

[0084]   If a high-speed carrier is detected but success in

training is not detected, receiving of information in the

information receiving step may be performed in accordance

25   with the first training information acquired in the first

training information acquisition step.

[0085]   In the embodiments described above, in the case in which success in training is not detected in step S70 or S106, training information, which was frozen in step S68 or S104 in the modem 8, is not read from the modem 8 and is not stored into the RAM 18. Alternatively, the training information may be read from the modem 8 and stored in the RAM 18, if this training information is not used in following communication.

[0086]   While the present invention has been described with reference to what are presently considered to be the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. On the contrary, the invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.